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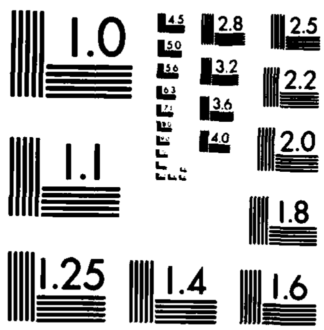

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Documentation was developed for the Parts Requirements and Cost Model (PARCOM) developed at the US Army Concepts Analysis Agency. PARCOM was designed to provide the Army with an analytical tool for quick reaction, gross estimation of wartime spare parts requirements and costs as they relate to flying hour and availability objectives. An ability to identify problem parts and possible causes of the problems was also desired. The PARCOM User's Guide is structured to provide a user with sufficient		

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Block 20 - ABSTRACT continued

information on model input/output and operation to effectively apply PARCOM. Additional information on model application may be found in the PARCOM Functional Description, published separately.

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DOCUMENTATION
CAA-D-84-10

PARTS REQUIREMENTS AND COST MODEL (PARCOM) DOCUMENTATION PARCOM USER'S GUIDE

OCTOBER 1984

PREPARED BY
FORCE SYSTEMS DIRECTORATE

US ARMY CONCEPTS ANALYSIS AGENCY
8120 WOODMONT AVENUE
BETHESDA, MARYLAND 20814-2797

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PARTS REQUIREMENTS AND COST MODEL (PARCOM) DOCUMENTATION

PARCOM USER'S GUIDE

CHAPTER 1

GENERAL DESCRIPTION

1-1. PURPOSE OF THE USER'S GUIDE. The purpose of this user's guide is to provide user personnel with the information necessary to effectively utilize the Parts Requirement and Cost Model (PARCOM). PARCOM is a planning support system for the logistics analyst/planner which permits the examination of three critical logistics issues:

- The shortfall of current fleet combat capability relative to required capability based on a specified current spares inventory.
- The "best" spares mix and associated fleet combat capability achievable with a limited amount of funds for add-on spares.
- The spares cost required to sustain a fleet flying program for a specified number of days and, conversely, the number of days of such sustainability achievable with a specified spares "budget."

1-2. PROJECT REFERENCES

a. Parts Reqirements and Cost Model (PARCOM) Functional Description, CAA-D-84-15, US Army Concepts Analysis Agency, October 1984.

b. Aircraft Spares Stockage Methodology (Aircraft Spares) Study, CAA-SR-84-12, US Army Concepts Analysis Agency, April 1984.

c. Pickard, W. C., Zellner, P. A., and Bailey, D. R., DOD Assimilation of US Air Force Methodologies for Relating Logistics Resources to Materiel Readiness, Synergy, Inc., August 1983.

1-3. TERMS AND ABBREVIATIONS. The following listing provides an explanation of any terms or acronyms subject to interpretation by the reader:

acft	aircraft
ASL	authorized stockage list
avail	availability
CAA	US Army Concepts Analysis Agency
cum	cumulative

frac	fraction
full sub	full substitution (part replacement policy)
hr	hour
ID	identification
MAX FLY	Maximization of Daily Flying Hours (study)
min	minimum
NMC	not mission capable
NMCS	not mission capable supply
no sub	no substitution (part replacement policy)
NRTS	not repairable this station
nr	number
NSN	national stock number
OST	order and ship time
PARCOM	Parts Requirements and Cost Model
PLL	prescribed load list
repl	replacement
req	required
rqmnt	requirement(s)
sub	substitution

1-4. SECURITY AND PRIVACY. All program code and listings are UNCLASSIFIED and require no special security considerations.

a. The classification of output reports depends on the specific data base used and the type and labeling of generated output. All example output in this report is UNCLASSIFIED.

b. The classification of input files is also a function of the data base used and the user's use of labeling. All example input in this report is UNCLASSIFIED.

CHAPTER 2

SYSTEM SUMMARY

2-1. SYSTEM APPLICATION

a. Requirements Mode. PARCOM provides information to logistics staff officers on the amounts and costs of cost-effective mixes of aircraft spare parts required to achieve a specified flying program under various:

- Cost constraints.
- Initial inventory conditions.
- Part replacement policies.
- Aircraft availability constraints.

The options for requirements cases are summarized in Table 2-1. A row of "X" entries denotes the simultaneous assignment of conditions defining each general case. The entry in the last column tells whether the combination of options is currently feasible for PARCOM solution.

Table 2-1. Key Attributes of Requirements Cases

Flying hour objective		Aircraft availability objective		Cost objective		Replacement policy		Feasi-bility
Consecutive daily achieved	Maximum cumulative achieved	No specified aircraft avail-ability	Minimum daily aircraft avail-ability	Unconstrained funds	Constrained funds	Full substitution	No substitution	
X	X	X		X			X	YES
X	X	X		X		X		YES
X	X		X	X			X	YES
X	X		X	X		X		YES
X		X			X		X	YES
X		X			X	X		NO
X			X		X		X	YES
X			X		X	X		NO
	X	X			X		X	YES
	X	X			X	X		NO
	X		X		X		X	YES
	X		X		X	X		NO

(1) **Unconstrained Costs.** With unconstrained costs, a user has unlimited funds but wishes to spend the least amount for an add-on spare buy which will enable the fleet to achieve a specified goal/objective. Within each unconstrained cost case the following options apply:

(a) **Goal/Objective.** The basic goal is "sparing to flying hours," i.e., generating a parts mix which will achieve a specified flying hour program at least cost. An additional goal of a minimum required (daily) aircraft availability can also be used. In this context, aircraft availability = 1 - NMCS, where NMCS = the fraction of surviving aircraft in "not mission capable supply" status.

(b) **Initial Inventory.** Initial inventory may be set to current inventory for each item. PARCOM will then compute the least cost add-on requirement. The model, however, can also generate a solution with the initial inventory set to zero. Such a solution is both an add-on (to zero) as well as a total requirements solution.

(c) **Parts Replacement Policy.** Whether or not a failed critical part degrades aircraft flying hour productivity depends on the parts replacement policy used. Under a "no substitution" policy, only a spare may replace a failed part. Under a "full substitution" policy a failed part may be replaced by either a spare <u>or</u>, if a spare is not readily available, by a serviceable part removed from an aircraft which is already NMC (not mission capable). A third parts replacement policy is "NMCS = 0," which has, as a goal, the replacement of <u>all</u> failed parts with spares. Basically the "NMCS = 0" policy is just a "no substitution" policy with an additional requirement that daily aircraft availability be 1.00. This variation is of interest since it represents the most expensive plausible policy. In a sense, all else being equal, a "full substitution" policy is associated with the "cheapest" buy which fulfills the flying program, while the "NMCS = 0" policy is associated with the "most expensive" buy ("covering" all failures with spares).

(2) **Constrained Costs.** While the unconstrained cost solution is the one that "best" meets the flying program, a requirements buy may not be affordable if funds are limited. With constrained costs, a user wishes to apply limited funds to buy a cost-effective slice of the requirements best buy. The associated options are:

(a) **Goal/Objective.** With a "no substitution" policy (see paragraph (c) below), the basic goal is to maximize the number of "required" parts (given unconstrained funds) which are purchased with the constrained budget. Such a goal tends toward maximizing the fraction of the flying program achievable with the constrained budget. Thus, the flying program (possibly in conjunction with aircraft availability constraints) is a part of the goal/objective.

(b) **Initial Inventory.** The basic constrained cost solution assumes initial inventory = current inventory and computes an add-on solution. As an option, the model also computes a solution with the initial inventory =

0, with the total cost constraint equal to the value of the current inventory plus the add-on cost constraint. Such a solution is predicated on getting a refund for current inventory--a case of limited practical interest.

(c) Parts Replacement Policy. Only a "no substitution" parts replacement policy is treated in constrained cost cases. Resource limitations and methodological complications precluded inclusion of a constrained cost mode with "full substitution."

(3) Treatment of Case Objectives. As shown in Table 2-1, the user specifies a flying hour objective in conjunction with availability objective. For each of these, one of two subobjectives is determined. Details on the nature of these subobjectives are discussed below.

(a) Maximizing Cumulative Flying Hours Achieved. This is the standard subobjective met when running a constrained cost case. It entails the direct determination of the parts mix which will yield the greatest number of achieved flying hours for a specified cost limit. The flying hours achieved will be less than the desired flying hour program if the cost limit is less than the cost of the unconstrained cost solution mix.

(b) Maximizing Consecutive Days of Flying Hour Program Achievement. This subobjective, as the previous one, is only relevant to constrained cost cases. For unconstrained cost cases, achieved flying hours will equal programed flying hours, and consecutive days of flying hour program achievement will equal the total days programed for the assumed war. The solution mix meeting this constrained cost objective is obtained through a two-stage process. First the user applies PARCOM to generate an unconstrained cost "no substitution" solution. The output list from that run shows, for each day, the cumulative cost of the add-on parts that would have been required if the war were truncated at that day. D, the last day on that list for which the associated "no substitution" cost is less than or equal to the "cost limit" of the constrained cost case, is then the maximum number of consecutive days sustainable at 100 percent program flying hours with "cost limit" spares dollars. Next, the desired solution mix is obtained by running PARCOM again, in an unconstrained cost mode, with a truncated war of D days in length.

(c) Minimum Specified Daily Aircraft Availability. This subobjective is in addition to any flying hour objective and is operative in all cases. The availability objective may increase the demand for available aircraft beyond those required to achieve the flying program. The input availability constraints are, as described previously, used to calculate daily "allowed NMCS aircraft," which, in turn, is used in all case calculations.

(d) No Specified Daily Aircraft Availability. PARCOM must always read in values for minimum daily aircraft availability objectives: however, entering blank or zero equates to not specifying an availability.

- **Record Set 9**

  - IMSEL must be less than or equal to 5.

  - The "part numbers" for IPT(K) must be the internal PARCOM subscripts for the specified part types. These are printed in the Parts Input Data List at the beginning of output where the entire part data base is "echoed" with the "part number" appended for those parts processed. Data on parts not processed are also printed in that list, but no part number is appended.

- **Record Set 3**

  - CLNCR is also added to the value of current inventory for processed parts (with nonzero failure rate) to establish a computed cost limit for the total (initial inventory = 0) requirements case with constrained cost.

  - LIMIT should normally be set to 4 or less. A high value of LIMIT increases processing time for capability assessment. The higher the value of LIMIT, the closer is the convergence of "flying hours flown" in the capability assessment calculation. The closeness is printed in the output; so the user has a guide for "trial and error" tests.

- **Record Set 4**

  - The IOPT1 through IOPT5 options only suppress printing. Calculations are still done. The IOPT6 option does suppress calculation as well as printing.

  - The IPRT4 can save considerable processing time in a run if it is set to NW. In that instance, all computations are done <u>except</u> for the "cumulative requirements through day N" table for "no substitution." Note: IPRT4 should always exactly divide into NW (number of days in war).

- **Record Set 5**

  - The NAC(I) must be input in the same order as the IDAY(I). Similar remarks apply to Record Sets 6-8.

- **Record Set 6**

  - For I = NFHDAY, NFH(I) is the daily flying hours from IDAY(I) through NW (end of war). Similar remarks apply to Record Sets 7-8.

- **Record Set 8**

  - "No availability constraint" can be modeled by having one interval (NMDAY = 1) with IDAY(1) = 1, and AM(1) = 0.

b. Figure 2-2 shows a sample scenario data base.

```
        0.    9
TEST NUMBER 1
           4300.     2
      10.     5          1    1    1    1    1    1              1    1
   2
   1    2
 150  200
   4
   1    2    4    5
 500 1000 1500 1500
   1
   1
  0.
   2
   1    2
 .10  .09
   2
   1    2
```

Figure 2-2. Scenario Data Base

2-9. REMARKS ON SCENARIO DATA BASE. The following remarks amplify and clarify the meaning and use of several elements of the Scenario Data Base defined in Table 2-5:

- **Record Set 1**

  - ADDOST was needed in PARCOM demonstration runs only because the Overview parts data base used by CAA had a zero entry for order ship time. A properly constructed Overview parts data base would use ADDOST = 0.

  - CONVF should be set to a small positive number less than .05. Both CONVF and LIMIT determine duration of capability assessment processing for constrained cost. See Chapter 3 for an example application of CONVF.

  - IESS could be set = 1 for a parts data base in which all "essential items" are coded 1.

Table 2-5. Scenario Data Base Format
(page 4 of 4 pages)

Columns	PARCOM name	Dimension	Format	Description
Record Set 8 (cont)				
1-80	IDAY(I)	61	16I5	Initial day of interval (in increasing order) requiring specified "minimum required aircraft availability"
1-80	AM(I)	61	16I5	Daily "minimum required aircraft availability" for each day from IDAY(I) through the day before IDAY(I+1), or through day NW
Record Set 9				
1-5	IMSEL	1	I5	The number of part types for which "cumulative requirement total for each day" will be printed in the Cumulative Stock Requirement List for Selected Items
1-80	IPT(K)	5	16I5	The "part numbers" (from echoed Part Input Data List) of the specified (IMSEL) part types to be represented in the Cumulative Stock Requirement List for Selected Items

Table 2-5. Scenario Data Base Format
(page 3 of 4 pages)

Columns	PARCOM name	Dimension	Format	Description
Record Set 5 (cont)				
1-80	NAC(I)	61	16I5	Cumulative number of aircraft deployed by IDAY(I). These are input in the same order as IDAY(I). NAC(I) applies from day IDAY(I) through day IDAY(I+1)-1, or (for the last interval) through day NW
Record Set 6				
1-5	NFHDAY	1	I5	Number of day intervals for which daily program flying hours are specified
1-80	IDAY(I)	61	16I5	Initial day of interval (in increasing order) for specified (by NFH(I) below) program flying hours
1-80	NFH(I)	61	16I5	Daily program flying hours for each day from IDAY(I) through the day before IDAY(I+1), or through day NW.
Record Set 7				
1-5	NLDAY	1	I5	Number of day intervals for which daily aircraft attrition losses are specified
1-80	IDAY(I)	61	16I5	Initial day of interval (in increasing order) for specified daily aircraft losses
1-80	ZLOSS(I)	61	16F5.1	Daily aircraft losses for each day from IDAY(I) through the day before IDAY(I+1)
Record Set 8				
1-5	NMDAY	1	I5	Number of day intervals for which a "minimum required aircraft availability" is specified

Table 2-5. Scenario Data Base Format
(page 2 of 4 pages)

Columns	PARCOM name	Dimension	Format	Description
Record Set 4 (cont)				
26-30	IOPT2	1	I5	Option (0 = omit, 1 = do) to print requirements list for unconstrained cost residual requirements solution
31-35	IOPT3	1	I5	Option (0 = omit, 1 = do) to print requirements list for constrained cost "total buy" solution (see Remarks)
36-40	IOPT4	1	I5	Option (0 = omit, 1 = do) to print requirements list for constrained cost add-on buy solution
41-45	IOPT5	1	I5	Option (0 = omit, 1 = do) to print total cumulative daily requirements for selected items (see Remarks)
46-50	IOPT6	1	I5	Option (0 = omit, 1 = do) to do the constrained cost case
61-65	IPRT	1	15	Option (0 = omit, 1 = do) to print the scenario input data summary
66-70	IPRT4	1	I5	Interval (days) at which "cumulative requirements through day N" are calculated for the "no sub" unconstrained cost requirement cases
Record Set 5				
1-5	NACDEP	1	I5	Number of day intervals (see IDAY(I) below) for which aircraft deployments are specified
1-80	IDAY(I)	61	16I5	Initial day of interval (in increasing order) for specified (by NAC(I) below) aircraft deployment

Table 2-5. Scenario Data Base Format
(page 1 of 4 pages)

Columns	PARCOM name	Dimension	Format	Description
Record Set 1				
1-5	ADDOST	1	F5.2	Offset (days) added to order ship time read from parts data base
6-10	CONVF	1	F5.2	Convergence goal for "flying hours flown" calculation during capability assessment (see Remarks)
11-15	IESS	1	I5	Maximum essentiality code for a part type to be processed
Record Set 2				
2-17	CASE	1	A16	Case (run) identification
Record Set 3				
2-15	CLNCR	1	F14.0	Add-on cost limit (dollars) for constrained cost cases
16-20	LIMIT	1	I5	Maximum number of iterations of "flying hours flown" calculations during capability assessment (see Remarks)
Record Set 4				
2-10	FHM	1	F9.1	Maximum flying hours/aircraft/day
11-15	NW	1	I5	Number of days in war (length of scenario)
21-25	IOPT1	1	I5	Option (0 = omit, 1 = do) to print requirements lists for unconstrained cost total requirements solution

Table 2-4. Parts Data Record Format

Record number	PARCOM name	Columns in field	Format	Description
1	Z1	3-17	A15	National stock number of part
	Z2	18-26	F9.0	100 * unit cost (dollars) of part
	Z3	32-34	F3.0	Order ship time (days) for part (= 0 for all parts in example data)
	Z4	35-39	F5.0	1,000,000 * failure rate (failures per flying hour) for part
	Z5	40-42	F3.0	NRTS (not repairable this station) percentage, i.e., percent of failures sent to depot for repair
	Z6	43-45	F3.0	Retail repair time (days) for part
	Z7	46-48	F3.0	Depot repair time (days) for part
	Z8	49-51	F3.0	Retail condemnation rate (percent scrapped at retail repair)
	Z9	52-54	F3.0	Depot condemnation rate (percent scrapped at depot repair)
	IES	55	I1	Essentiality code of part (1 = most essential)
	INIT	66-70	15	Initial inventory (wholesale + retail) for part
5	IQPA	1-2	I2	Quantity per application, i.e., number of parts installed per aircraft
6	ADSC	1-16	A16	Description of part

2-8. SCENARIO DATA BASE FORMAT

a. The scenario data base read by PARCOM consists of 9 sets of card image records, as shown in Table 2-5, which summarize names, formats, and descriptions. Record sets 1 through 4 always have exactly 1 card. Record set 9 always has 2 cards. The length of record sets 5-8 depends on user specification as noted below. All record sets must be present. Aircraft availability constraints are "omitted" by setting AM (I) = 0 in Record Set 8 for all days. Remarks on Table 2-5 are given after the table in order of input.

2-7. PARTS DATA BASE FORMAT. The parts data base read by PARCOM consists of 3 file header records, which are skipped, followed by a series of sets of 12 records, each set being associated with data for a single part type. PARCOM reads from only 3 of the 12 records in each set, the first, fifth, and sixth records. The rest are skipped. The program could be altered to read a compressed parts data package which could be constructed by preprocessing an Overview parts data base to "select out" the elements used by PARCOM. Table 2-4 gives the names, as used by the PARCOM READ statement, and formats of the parts data elements input for each part type. "Record number" in the table refers to the ordinal position of a data record within the 12-record block for a part type. "Columns in field" refers to the character positions, within a record, occupied by the tabulated data element. "Format" refers to the FORTRAN language format specification currently used. "Description" is a summary definition of the data element. Note that some of these input data are scaled (multiplied by a constant factor). PARCOM also converts all percent rates to fractions.

a Figure 2-1 shows a sample parts data base containing only two part types.

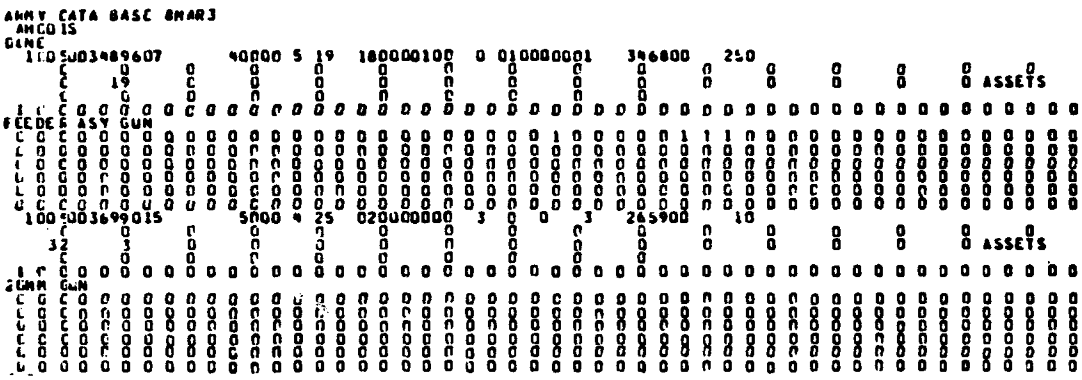

Figure 2-1. Parts Data Base

b. All data read in are screened for processing. Only parts with nonzero failure rates and with specified essentiality are processed and assigned part numbers for internal PARCOM reference. Nonprocessed parts data is "echoed" (printed) but is thereafter ignored. All data elements described in Table 2-4 are associated, via a subscripted array, with the "part number" of their associated part type. Currently, the PARCOM program limits allow up to 300 part types to be processed. By "initial inventory" is meant <u>total spares</u> including that in ASLs/PLLs not deployed. Since there are no explicit ASL/PLL "deployments" in PARCOM, all spares are "front loaded", i.e., made available at day 1. "Total spares" includes the sum of the following stocks: war reserve, depot stocks, stocks in units, stockpiled stocks for units, and stocks in pipeline.

Table 2-3. Data Elements for the Scenario Data Base

Scenario Specification Data

- Case identifier
- Length of war
- Flying program
- Aircraft deployment schedule
- Aircraft losses

Scenario Constraint Data

- Add-on cost limit (for constrained cost)
- Aircraft availability constraints (minimum daily availability)
- Maximum flying hours per aircraft per day

Additional Parts Data

- Order ship time offset
- Maximum essentiality code for part to be processed

Print/Calculate Options

- Options on printing of total and of residual requirements lists for unconstrained and for constrained cost cases
- Option on printing daily cumulative total requirements for selected items specified by user
- Option to omit all constrained cost calculations
- Option to limit the "cumulative requirements by day" calculations for "no substitution" to user-specified intervals
- Option to print a scenario input data summary

Tuning Parameters

- Desired closeness of "flying hours flown" convergence during capability assessment
- Maximum number of iterations used to calculate "flying hours flown" during capability assessment

Table 2-2. Data Elements for Each Part Type in the Parts Data Base

(1)	National Stock Number (NSN)
(2)	Unit cost
(3)	Retail repair time
(4)	Depot repair time
(5)	Order and ship time
(6)	Failure rate
(7)	Retail NRTS rate
(8)	Retail condemnation percentage
(9)	Depot condemnation percentage
(10)	Item Essentiality Code
(11)	Quantity per application
(12)	Initial inventory

b. The rest of the PARCOM input data base is denoted by "the scenario data base" and consists of scenario specification data, scenario constraint data, additional (to parts data base) parts data, and print/calculate options. These are summarized in Table 2-3. These records are all card image. During PARCOM execution the parts data base is read between the first and last scenario data base records. Therefore, the two aforementioned data bases should always be read on separate logical units if, as is now the case, the two data bases are separately formatted and constructed.

scenario data, for the current maximum capacity of 300 part types in a (maximum) 120-day scenario, consists of approximately 40-120 records depending on the day-to-day variation in specified aircraft deployments, flying program, and availability goals.

b. Output. The parts data input is "echoed," i.e., printed in an output list. A variety of reports on spare requirements (costs and amounts, total and by part type), and resulting capability (aircraft availability, fraction flying goal achieved, and flying hours per aircraft per day) are printed. For each demonstration case at maximum capacity, the volume of printed output is 60 pages.

c. Limitations. The model is currently designed for, at most, 300 part types processed over, at most, a 120-day scenario. However, these limits may be increased by altering the DIMENSION and COMMON statements of the FORTRAN code, insofar as available computer memory allows. Further extension of capacity can be achieved by "splitting" PARCOM into several submodels, each of which processes only a specific problem, from the set currently treated in a single "run" of a single model. With its current limits, PARCOM uses 33K of memory on the Sperry 1100/82 computer at CAA.

d. Processing Time. The central processing time required for a PARCOM execution depends on the scenario length and the number of part types processed, as well as the types of problems processed. A complete PARCOM execution with the above limits consumes approximately 220 central processing seconds on the CAA computer.

e. Flexibility. PARCOM was designed to accommodate numbers of part types and scenario lengths beyond the programed limits by allowing the user to modify only the DIMENSION and COMMON statement limits in the FORTRAN code. In doing so, the user must consider both his/her computer memory limits and the increased processing time required to run larger problems. During the PARCOM documentation/transfer phase, CAA will investigate ways of representing "partial substitution" with the basic PARCOM methodology.

2-6. DATA BASE

a. The major portion, in terms of quantity of records, of the PARCOM input data base is from the parts data base designed for the Overview Model. PARCOM uses the data elements shown in Table 2-2. The Overview parts data base is described in a SYNERGY, Inc. report (see reference in paragraph 1-2b). Only a portion of the information in the Overview parts data base is read and used by PARCOM. Since the parts data base has records of 102 characters in length, it is not read as card image (80 characters per record), and therefore, must be read from a peripheral storage device (tape or disc).

capability with which the "achievable capability" generated from a requirements solution mix might be compared.

2-2. SYSTEM OPERATION

a. PARCOM is designed to operate from card image input constructed by the user, along with a parts data bas in the format used by the Overview Model in the US Army Concepts Analysis Agency (CAA) Maximization of Flying Hours (MAX FLY) Study. A peripheral storage device (tape or disc) is used to store the parts data base, since it is not a card-image format.

b. PARCOM output consists almost entirely of printed files. The type and quantity of output can be controlled to a degree by user-specified input options.

2-3. SYSTEM CONFIGURATION. The current PARCOM version was developed for the Sperry 1100/82 Multi-Processing System at CAA. The model is coded in FORTRAN.

2-4. SYSTEM ORGANIZATION. PARCOM is implemented as a single processor which:

- Reads part type data/characteristics from a peripheral storage device.
- Reads card image scenario data supplementary to the parts data. The scenario data also specify the goal/objective for the solution requirement mix(es).
- Generates cost-effective requirements solution mixes (costs and composition) of spares based on the specified goals.
- Generates achievable combat capability (readiness, flying hours) reflected in the solution spares mixes.

As noted earlier, a single PARCOM execution can generate requirements solution mixes for a variety of initial inventory conditions, parts replacement policies, and cost constraints.

2-5. PERFORMANCE

a. Input. The parts data base for PARCOM is in the format used by the Overview Model, as modified for CAA. The data base consists of 12 records for each part type, with each record being up to 102 characters in length. For the current maximum capacity of 300 part types, the Overview/PARCOM parts data base would have 3,603 records (3 "label" records begin the data base). However, since only 3 records are read by PARCOM from each "part type" set of 12, only 900 of the 3,603 records are used. The card image

(4) Capability Value of Requirements Mixes. After a requirement solution mix is computed, PARCOM will also generate a record of daily achievable fleet flying capability implied by use of that solution mix. The capability assessment measures are:

- Daily achievable aircraft availability.
- Daily achievable fraction of flying program completed.
- Daily achievable flying hours per available aircraft per day.

Overall average (over the scenario length) values of these measures are also computed. In the requirements mode, PARCOM capability assessment results superficially show the logistics planner cases in which the costs of correcting capability shortfalls are based only on filling inventory shortfalls (i.e., by buying spares). However, the results may also suggest the need to examine the cost effectiveness of other ways to meet the flying program objective. For example, intensive management or improved efficiency in repair and processing cycles might reduce requirements by shortening the length of the logistics pipeline. In addition, product improvement programs might reduce requirements by lowering failure rates. Applied with the constrained cost option, PARCOM could be used to compare improvements in flying hour program capability from applying a fixed number of dollars, C, to "pipeline/failure rate improvement" with improvements from "buying spares." The capability with a qualitatively improved current inventory can be compared to the capability resulting from the constrained cost solution obtained by using the C dollars to efficiently "buy spares."

b. Capability Assessment Mode. While designed primarily as a requirements assessment model, PARCOM can also assess the capability of an aircraft fleet with a specified (e.g., current) spare inventory to meet a flying hour objective. However, the nature of the feasible capability assessment depends on the part replacement policy treated. Given a specified wartime flying hour program objective, PARCOM can assess the number of consecutive days of 100 percent flying program achievement and the fraction of the cumulative program hours achievable with any starting inventory and a "no substitution" replacement policy. It can also assess consecutive days of 100 percent achievement for a "full substitution" policy but not the fraction of the program achieved. In order to assess consecutive days of 100 percent achievement in both cases, the user operates PARCOM in any standard run with input-specified current inventory. One output from that run gives cumulative, by day of war, cost of the residual (add-on) requirement for a scenario truncated at the specified day. The latest (last) day for which there is a zero add-on requirement cost is the last day of the period of sustainability with current inventory. The capability associated with current inventory is assessed by treating cur-rent conditions as a special case of a constrained cost capability assess-ment with an add-on limit of zero dollars. The primary use of the capability assessment mode would probably be to establish a baseline current

CHAPTER 3

MODEL OUTPUT

3-1. INPUT CONSTRAINTS. The user can limit the amount of output produced by the values assigned to the inputs IOPT1, IOPT2, IOPT3, IOPT4, IOPT5, IOPT6, and IPRT4 as described in Table 2-4. In addition, any case can be truncated by setting input NW (number of days in war) to a suitably low value.

3-2. SCOPE OF CASES PROCESSED

a. Cases Processed. Figure 3-1 shows the eight cases processed in a single PARCOM run. The subdivisions represent parametric variations in:

(1) Cost constraints - with and without.

(2) Initial inventory of parts - zero or as selected (usually current).

(3) Parts replacement policy - "full substitution," "no substitution," or "NMCS = 0."

Entries shown as "XXX" indicate user-defined input values. Figure 3-1 graphically represents a "nested umbrella" of conditions defining each of the eight cases identified, i.e., all blocks above Case ID in the chart state the defining conditions of that case. These are also implicit in the Case ID, interpreted as follows:

First character - scenario: A.

Second character - cost constraints:
U = unconstrained or C = constrained.

Third character - full or add-on requirements:
T = full (total) requirements or R = add-on (residual) requirements.

Fourth character - part replacement policy:
1 = full substitution, 2 = no substitution, or
3 = (NMCS = 0).

Note that the "full requirements" case is equivalent to initial inventory = 0, while the "add-on requirements" case is equivalent to initial inventory = current inventory (or as otherwise entered). Using this notation, AUR2 represents the case: Scenario A, unconstrained costs, residual (add-on) requirements, and a "no substitution" parts replacement policy.

Case stratification for any chosen scenario	Scenario A											
	Acft availability constraints (.XXX...)											
	Unconstrained						Constrained cost Added-buy limit=$XXX					
	Initial inventory =0			Initial inventory Part 1 = XXX Part 2 = XXX . . .			Initial inventory =0			Initial inventory Part 1 = XXX Part 2 = XXX . . .		
	Full rqmts			Add-on rqmts			Full rqmts			Add-on rqmts		
	Full sub repl policy	No sub repl policy	NMCS =0 repl policy	Full sub repl policy	No sub repl policy	NMCS =0 repl policy	Full sub repl policy	No sub repl policy	NMCS =0 repl policy	Full sub repl policy	No sub repl policy	NMCS =0 repl policy
Case ID	AUT 1	AUT 2	AUT 3	AUR 1	AUR 2	AUR 3	ACT 1	ACT 2	ACT 3	ACR 1	ACR 2	ACR 3
Total rqmt	X	X	X					X	X[a]			
Residual rqmt				X	X	X					X	X[a]
Cum cost by day (all parts)	X	X	X	X	X	X	X	X	X	X	X	X
Cum req by day (selected parts)	X	X	X				X	X	X			
Daily AC avail	X	X	X	X	X	X		X	X[a]		X	X[a]
Daily fly hr frac[b]	X	X	X	X	X	X		X	X[a]		X	X[a]

[a]Produced whenever no-substitution policy with an availability goal = 1.00 is processed.

[b]The daily flying hour fraction = 1.00 for all days if the unconstrained cost solution requirement is stocked.

Figure 3-1. Type Outputs Produced for Each Case Within a PARCOM Scenario

b. **Summary of Output.** Figure 3-1 also shows the available output produced for each case generated within a PARCOM scenario. An "X" in the matrix indicates availability of the type output, described in the left margin, for the case with the "Case ID" shown above the "X". The absence of an "X" indicates unavailability. Shaded boxes are for inapplicable cases. A brief description of each type output is given below. A complete descriptive listing of PARCOM output tables, with samples, is given in the next major paragraph.

(1) **Total Requirement.** Total (initial inventory = 0) least-cost parts required to achieve the flying program (unconstrained dollars), or total "best" parts mix purchasable (constrained dollars).

(2) **Residual Requirement.** The least-cost add-on buy, to initial inventory, which will achieve the flying program (unconstrained dollars), or the "best" add-on buy to initial inventory (constrained dollars).

(3) **Cumulative Cost by Day.** For each Day N, the total cost of the parts requirement to sustain the scenario flying program through Day N <u>only</u>, i.e., it is the requirement for a truncated scenario of N days in length.

(4) **Cumulative Requirement by Day.** For selected items for each Day N, the cumulative total (initial inventory = 0) requirement needed for the flying program to be sustained through N days.

(5) **Daily Aircraft Available.** For each day of the full scenario, the fraction of surviving aircraft which are <u>not</u> NMCS, assuming that the initial spare inventory is set equal to the computed parts requirement.

(6) **Daily Flying Hour Fraction.** For each day of the full scenario, the fraction of the fleet flying program which can be achieved assuming that the initial spare inventory is set equal to the computed parts requirement.

(7) **Daily Flying Hours per Available Aircraft per Day.** For each day of the full scenario, the maximum achievable program flying hours per aircraft assuming that the initial spare inventory is set equal to the computed parts requirement.

3-3. SAMPLE OUTPUTS. A complete list of standard outputs is presented below in the sequence of output. Figures of sample outputs and descriptive explanations are given. For convenience, the sample outputs are restricted to a case involving two part types over a 5-day war. The order of outputs is:

a. Parts Input Data List (Figure 3-2). The raw parts data is "echoed" in labeled form. The order of parts is as input. The entries under the PART heading are the "part numbers" which are cross-referenced in other lists. COST denotes unit cost of the part. OST denotes the order/ship time in days. FAIL RT denotes failure rate in failures per flying hour. NRTS gives the "not repairable this station" fraction. BCY denotes the base repair time (in days). DCY denotes the depot cycle time in days, i.e., the time from removal until return from depot repair. It is the sum of the depot repair time and 2 x OST. DRT denotes depot repair time. BCON denotes the fraction of failed parts which are condemned (scrapped) at retail repair. DCON denotes the fraction of failed parts sent to depot repair and subsequently condemned at that level of repair. QPA denotes the quantity per application for the part, i.e., the number of units of that part type installed per operational aircraft. ESS denotes the essentiality code of the part. While all part data is "echoed" in this list, only those parts with nonzero failure rates and with essentiality code less than or equal to a user-specified level (IESS) are assigned part numbers. Listed part data not assigned a part number are not subsequently processed. After the last item of the parts list, the total number of input part types (TOTAL NR PARTS) is given along with the number of these part types to be processed by PARCOM (NR USED). The INIT STK column echoes the initial stock (INIT) entry in the parts data base. It reflects total spare assets (see para 2-7b.

CASE=

ITEMS RANK ORDERED IN NORMAL INPUT ORDER

PART	NSN	DESCRIPTION	COST	OST	FAIL RT	NRTS	BCY	DCY	DRT	BCON	DCON	QPA	ESS	INIT STK
1	1005003489607	FEEDER ASY GUN	400.	1.	.080000	1.00	0.	3.	1.	.00	.03	1.	1	250
2	1005003699015	20MM GUN	50.	0.	.020000	.00	3.	0.	0.	.00	.00	1.	3	10

TOTAL NR PARTS= 2 NR USED= 2

Figure 3-2. Part Input Data List

b. Input-ordered Cost/Stockage List (Figure 3-3). This list shows the unit cost and initial inventory for each part processed. Parts are in order of input. Part numbers shown are defined as in paragraph 3-a above. The rank heading is redundant here, but is subsequently used in presenting this data ordered by part unit cost. The part numbers are cross-referenced with those in the Part Input Data List.

CASE=TEST NUMBER 1

ITEMS RANK ORDERED IN NORMAL INPUT ORDER

RANK	PART	MSN	DESCRIPTION	COST	INIT STK
1	1	1005003489607	FEEDER ASY GUN	400.	250
2	2	1005003699015	20MM GUN	50.	10

Figure 3-3. Initial Inventory Stock List

c. **Scenario Input Data Summary (Figure 3-4).** This output "echoes" much of the scenario input data. It includes a table showing, on a daily basis, the cumulative aircraft deployed, the program flying hours, the minimum aircraft availability objective, the aircraft lost (attrition), and the cumulative aircraft lost. This table has sufficient information to enable the model user to convert a PARCOM-generated aircraft availability into "number of aircraft available" and a "fraction flying hour program achieved" into "number of program hours achieved".

CASE=TEST NUMBER 1

SCENARIO INPUT DATA SUMMARY

USI OFFSET= .0 DAYS DESIRED CONVERGECE= .000 MAX ITERATIONS= 2 MAX ESSENTIALITY= 9

MAX FLY HRS/ACFT/DAY= 10.0 ADD-ON COST LIMIT= 4300. NO SUB CUM RQMT COST CALC EA 1 DAYS

DAY	CUM ACFT DEPLOYED	PROGRAM FLY HRS	MIN REQ AVAIL	ACFT LOST	CUM ACFT LOST
1	150.	500.	.10	.0	.0
2	200.	1000.	.09	.0	.0
3	200.	1000.	.09	.0	.0
4	200.	1500.	.09	.0	.0
5	200.	1500.	.09	.0	.0

Figure 3-4. Scenario Input Data Summary

d. Current Inventory Cost Report (Figure 3-5). The amount shown is the dollar value of the total initial inventory of parts processed. Note that this amount excludes parts in the data base which are not processed (because of zero failure rate or inappropriate essentiality code). For parts processed, valuation is determined by accumulating the product of initial inventory and part unit cost.

```
                    CASE= TEST NUMBER 1


COST OF CURRENT INVENTORY=        100500.
```

Figure 3-5. Current Inventory Cost Report

e. Cost-ordered Parts List (Figure 3-6). It shows part number, part description, and part unit cost ranked in decreasing order of part unit cost. RANK denotes the rank order (over all processed part types). PART denotes the associated part number (as defined in paragraph 3-3a).

CASE=TEST NUMBER 1

ITEMS RANK ORDERED BY DECREASING PART COST

RANK	PART	MSN	DESCRIPTION	COST	INIT STK
1	1	1005003489607	FEEDER ASY GUN	400.	250
2	2	1005003699015	20MM GUN	50.	10

Figure 3-6. Cost-ordered Parts List

f. Unconstrained Dollar Total Requirements Total Cost List (Figure 3-7). The output shows the total cost of the least-cost total requirements unconstrained cost solution (based on zero initial inventory) for each of the three policies ("no substitution," "full substitution," and "NMCS = 0.") Costs are computed by cumulating the product of part unit cost and total units (of part) required.

CASE=TEST NUMBER 1

TOTAL(INIT STK= 0) COST OF POLICIES

POLICY	TOT COST
NO SUB	112000.
FULL SUB	109500.
NMCS=0	132000.

Figure 3-7. Unconstrained Dollar Total Requirements Total Cost List

g. Unconstrained Dollar Residual Requirements Total Cost List (Figure 3-8). The output shows the total cost of the least-cost residual requirements unconstrained cost solution (add-on based on input initial inventory) for each of the three policies.

CASE=TEST NUMBER 1

RESIDUAL(INIT STK=CURR STK) COST OF POLICIES

POLICY	TOT COST
NO SUB	11500.
FULL SUB	9000.
NMCS=0	31500.

Figure 3-8. Unconstrained Dollar Residual Requirements Total Cost List

h. Constrained Dollar Cost Limit Summary (Figure 3-9). The output is a printed summary of cost data required for the constrained cost case processing. The first such item is the "cost constraint of added buy," which is just the input cost limit (in dollars) of the constrained cost spares buy. The second item is "cost of current required inventory" which is just the total value, over processed part types, of initial inventory less than or equal to the "NMCS = 0" requirement. In computing this item, supply (inventory) in excess of total expected net demand (the "NMCS = 0" requirement) is ignored. Also input part types not selected for processing (because of zero failure rate or inappropriate essentiality code) are ignored. The third item is "total cost of current inventory plus added buy," which is just the sum of the input cost limit and the total value, over processed part types, of all initial inventory. Part types not selected for processing are ignored in this calculation. This item is used as the cost limit for the constrained cost total requirements case (zero initial inventory).

	NO SUBST
COST CONSTRAINT OF ADDED BUY=	4300.
COST OF CURRENT REQUIRED INVENTORY=	100500.
TOTAL (CURR INV+ADDED BUY) COST=	104800.

Figure 3-9. Constrained Dollar Cost Limit Summary

i. Unconstrained Dollar Total Requirements Parts List (Figure 3-10). The output shows the composition of the total unconstrained cost requirement solution mixes (zero initial inventory) for each policy. Parts requirements are listed in order of decreasing part unit cost (most expensive part is first). For each part and policy is listed:

(1) The number of units of that part required to achieve the case objective under the indicated policy. A zero initial inventory is assumed in the "total requirements" case.

(2) The cost of the requirement computed in (1), computed as the product of units required and part unit cost.

(3) The percent of the overall (i.e., overall parts) requirement represented by the requirement for the part type.

CASE= TEST NUMBER 1

TOTAL(INIT STK=0) STK RQMTS BY POLICY ** MINIMUM AC AVAIL= .09 ** PARTS IN ORDER OF DECREASING UNIT COST

PART		FULL SUBST RQMNT	FULL SUBST COST	FULL SUBST %COST	NO SUBST RQMNT	NO SUBST COST	NO SUBST %COST	NMCS=0 RQMNT	NMCS=0 COST	NMCS=0 %COST
1005C03489607	FEEDER ASY GUN	270.0	108000.	98.63	270.0	108000.	96.43	320.0	128000.	96.97
1005C03699015	20MM GUN	30.0	1500.	1.37	80.0	4000.	3.57	80.0	4000.	3.03

Figure 3-10. Unconstrained Dollar Total Requirements Parts List

j. **Unconstrained Dollar Residual Requirements Parts List (Figure 3-11).** The output shows the composition of the residual unconstrained cost requirement solution mixes (based on input initial inventory) for each policy. Format is virtually identical to that of the total requirements list, i.e., parts are listed in decreasing cost order and add-on units required, cost of add-on requirement, and associated percent of overall requirement are listed for each part and policy.

CASE= TEST NUMBER 1

RESIDUAL(INIT STK=CURR STK) STK RQMT BY POLICY *MINIMUM AC AVAIL= .09 ** PARTS IN ORDER OF DECREASING UNIT COST

PART		FULL SUBST RQMNT	FULL SUBST COST	FULL SUBST %COST	NO SUBST RQMNT	NO SUBST COST	NO SUBST %COST	NMCS=0 RQMNT	NMCS=0 COST	NMCS=0 %COST
1005C03489607	FEEDER ASY GUN	20.0	8000.	88.89	20.0	8000.	69.57	70.0	28000.	88.89
1005C03699015	20MM GUN	20.0	1000.	11.11	70.0	3500.	30.43	70.0	3500.	11.11

Figure 3-11. Unconstrained Dollar Residual Requirements Parts List

k. Unconstrained Dollar Total Requirements Force Capability List (Figure 3-12). The output shows, as discussed below, expected achievable daily aircraft availability, the "driving" factor in determination of availability objective, and flying hours per available aircraft per day for the "full substitution" and "no substitution" policies, assuming that the computed "unconstrained dollar total requirement" (listed in paragraph i above) is stocked and available on day 1.

CASE= TEST NUMBER 1

** FORCE CAPABILITY GIVEN THAT THE COMPUTED REQUIREMENT (FOR EACH POLICY) IS STOCKED **

*** CASES ASSUME TOTAL(INIT STK=0) REQMTS ARE STOCKED ***

	AIRCRAFT AVAILABILITY					FLY HRS / ACFT / DAY		
DAY	FULL SUB	NO SUB	REQ AVAIL	AVAIL SOURCE	AVAIL	FULL SUB	NO SUB	DAY
1	1.000	1.000	.333	FLYING HR PROG	.10	3.3	3.3	1
2	1.000	1.000	.500	FLYING HR PROG	.09	5.0	5.0	2
3	.900	1.000	.500	FLYING HR PROG	.09	5.6	5.0	3
4	.800	.950	.750	FLYING HR PROG	.09	9.4	7.9	4
5	.750	.750	.750	FLYING HR PROG	.09	10.0	10.0	5
AVERAGE=	.684	.937	.579			6.5	6.2	

Figure 3-12. Unconstrained Dollar Total Requirements Force Capability List

(1) **Aircraft Availability.** Aircraft availability, as applied in PARCOM, is defined as the fraction of surviving aircraft which are not in NMCS status. The minimum aircraft availability required on each day in order to meet the case objective is shown under the REQ AVAIL heading. The required availability must equal the larger of the availability reflected in the daily flying hour program and that specified by the input availability constraints. An initial aircraft availability of 1.00 is assumed.

(2) **Availability Source.** The "driving" source of the daily availability requirement is listed under the AVAIL SOURCE heading. FLYING HR PROGRAM denotes the daily flying hour program while AVAIL CONSTRAIN denotes an input availability constraint. In the AVAIL column immediately to the right of the AVAIL SOURCE entries are the daily input availability constraints input by the user. When the AVAIL SOURCE is AVAIL CONSTRAIN, these availabilities should be identical to corresponding entries in the REQ AVAIL column.

(3) **Flying Hours per (Available) Aircraft per Day.** These entries are computed by dividing the number of program flying hours for the day by the number of available aircraft on that day. The number of available aircraft is just the product of the tabulated aircraft availability and the number of surviving aircraft.

(4) **Averages Over Time.** After all daily status figures are listed, PARCOM prints achieved aircraft availability, minimum required availability, and achieved flying hours per aircraft per day. These are all weighted averages over time. In calculating the weighted averages, each daily availability entry is weighted by the number of surviving aircraft on that day, and each daily "flying hour per aircraft per day" entry is weighted by the number of available aircraft on that day.

l. **Unconstrained Dollar Residual Requirements Force Capability List (Figure 3-13).** The output is analogous to the comparable list for total requirements (paragraph k above), i.e., it shows, for each day, expected aircraft availability, required availability (and source), and flying hours per aircraft per day under the two-part replacement policies, assuming that the computed residual unconstrained cost requirement (listed in j above) is stocked (in addition to input initial inventory) and available.

CASE= TEST NUMBER 1

** FORCE CAPABILITY GIVEN THAT THE COMPUTED REQUIREMENT (FOR EACH POLICY) IS STOCKED **

*** CASES ASSUME RESIDUAL(INIT STK=CURR STK) REQMTS ARE STOCKED ***

	AIRCRAFT AVAILABILITY					FLY HRS / ACFT / DAY		
DAY	FULL SUB	NO SUB	REQ AVAIL	AVAIL SOURCE	AVAIL	FULL SUB	NO SUB	DAY
1	1.000	1.000	.333	FLYING HR PROG	.10	3.3	3.3	1
2	1.000	1.000	.500	FLYING HR PROG	.09	5.0	5.0	2
3	.900	1.000	.500	FLYING HR PROG	.09	5.6	5.0	3
4	.800	.950	.750	FLYING HR PROG	.09	9.4	7.9	4
5	.750	.750	.750	FLYING HR PROG	.09	10.0	10.0	5
AVERAGE=	.884	.937	.579			6.5	6.2	

Figure 3-13. Unconstrained Dollar Residual Requirements Force Capability List

m. Selected Items Cumulative Stock Requirement List (Figure 3-14). The output consists of total (zero initial inventory) unconstrained cost requirements for each of up to five selected part types for a truncated scenario of length N days, where N = 1, 2, ... through the last day of the base case scenario. Requirements are shown for each of the three policies. Each row of output corresponds to unconstrained cost total requirements for a "war" of length N as noted in the leftmost column. Excluding that column, each group of three consecutive columns gives requirements, by policy, for the part identified, by description and NSN, in the super-heading of each three-column set. The selected parts are specified by user input in Record Set 9 of the Scenario Input Data Base. The tabulated requirements represent an extract from the requirements computed over the full part data base (not over just the part types shown). The purpose of the output list is to allow the user to examine the changing demand, over time, for certain key parts under the various policies.

CASE= TEST NUMBER 1

CUM STOCK REQUIRED THROUGH GIVEN DAY

*** CASES ASSUME TOTAL(INIT STK=0) REQMTS ARE STOCKED ***

	1LC5003489607 FEEDER ASY GUN			1005003699015 20MM GUN											
F	FULL SB NO	SUB	NMCS=0	FULL SB NO	SUB	NMCS=0	FULL SB NO	SUB	NMCS=0	FULL SB NO	SUB	NMCS=0	FULL SB NO	SUB	NMCS=0
1	.0	.0	40.0	.0	.0	10.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2	20.0	20.0	170.0	.0	20.0	30.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3	100.0	100.0	200.0	.0	60.0	50.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4	230.0	230.0	280.0	20.0	70.0	70.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5	270.0	270.0	320.0	30.0	80.0	80.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

Figure 3-14. Selected Items Cumulative Stock Requirement List

n. Total Requirement Cumulative Cost List (Figure 3-15). The output consists of the total cost (all parts) of the total unconstrained cost requirements solution (zero initial stock) for each policy applied in a truncated scenario consisting of the first N days of the base scenario, where N = 1, 2, ... through the last day of the base scenario. The leftmost column shows the last day of the truncated scenario while the three entries on the same line show the total requirement cost by policy. As before, total cost consists of the product of units required and part unit cost, summarized over all part types processed. The costs on the last line (day) of the output list should be the same as those in the Unconstrained Dollar Total Requirements Cost List (paragraph f above). Another interpretation of this output is that it gives, for each policy, the expected cost for total requirements required to sustain the flying hour/availability objective through any specified day of the scenario.

CASE=TEST NUMBER 1

CUM TOTAL(INIT STK=0) COST OF REQ THRU GIVEN DAY

DAY	FULL SUB	NO SUB	NMCS=0
1	0.	0.	16500.
2	8000.	9500.	49500.
3	40000.	42500.	82500.
4	93000.	95500.	115500.
5	109500.	112000.	132000.

Figure 3-15. Total Requirement Cumulative Cost List

o. Cumulative Residual Stock Requirement Cost List (Figure 3-16). Output consists of total costs (all parts) of the residual unconstrained cost requirements solution (add-on based on initial inventory) for each policy applied in a truncated scenario of N days, N = 1, 2, ... through the last day of the base scenario. Total costs are computed in the same way as in paragraph n; however, these are add-on costs. Initial inventory is not costed here, but is treated as a "sunk" asset. The costs on the last line (day) of the output list should be the same as those in the Unconstrained Dollar Residual Requirements Cost List (paragraph g above). Another interpretation of this output is that it gives, for each policy, the expected cost, for residual (add-on) requirements, required to sustain the flying hour/availability objective through any specified day of the scenario.

CASE=TEST NUMBER 1

CUM RESIDUAL(INIT STK= CURR STK) COST OF REQ THRU GIVEN DAY

DAY	FULL SUB	NO SUB	NMCS=0
1	0.	0.	0.
2	0.	0.	1000.
3	0.	0.	2000.
4	500.	2000.	15000.
5	9000.	11500.	31500.

Figure 3-16. Residual Requirement Cumulative Cost List

p. Constrained Dollar Total Requirements Parts List (Figure 3-17). The output is only printed if the sum of the total cost of initial inventory and the input cost limit is less than the total cost of the unconstrained cost requirements solution for a "no substitution" policy. The first sum was noted at the end of the Constrained Dollar Cost Limit Summary (paragraph h above). If the cost of the unconstrained cost solution is the smaller of the two, then the unconstrained cost part mix is also the solution of the constrained cost total requirements problem. If a solution mix is printed, it consists of total requirements for each part (zero initial inventory), using a "no substitution" policy, based on a computed cost limit equal to the sum of the input cost limit and the "cost of current inventory" as noted above and in subparagraph h. The computed cost limit is also printed in the table header, viz., ---(= XXXXX) AVAIL FOR REALLOCATION. The XXXXX denotes the cost limit for the case. The output format is similar to that of the Unconstrained Dollar Total Requirements List (subparagraph i) except that the only entries are under the "no substitution" policy heading. The parts are listed in order of decreasing unit cost. Each processed part NSN and description are listed, along with the solution amount required, the cost of that amount, and the percent of overall cost (all parts) repre-sented by that amount. The solution represented tends toward the maximally productive (in terms of cumulative flying hours achieved) constrained cost "no substitution" total parts mix, based on zero initial inventory, which is "priced" at the computed cost limit.

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CASE= TEST NUMBER 1

TOTAL(INIT STK=0) STK REQ BY POLICY **FULL REQ COST LIMIT = 104800. ** PARTS IN ORDER OF DECR UNIT COST

** TOTAL (INIT STK=0)COST OF *CURR INVENTORY+ ADDED BUY* (= 104800.) AVAIL FOR REALLOCATION

PART		FULL SUBST RQMNT	COST	%COST	NO SUBST RQMNT	COST	%COST	NMCS=0 RQMNT	COST	%COST
1005C03489607	FEEDER ASY GUN				252.0	100800.	96.18			
1005C0369015	20MM GUN				80.0	4000.	3.82			

Figure 3-17. Constrained Dollar Total Requirements Parts List

q. Constrained Dollar Residual Requirements Parts List (Figure 3-18). The output format is analogous to Figure 3-17. However, Figure 3-18 shows the composition of the "maximally productive" add-on "no substitution" parts mix, which is "priced" at the input cost limit. The add-on is relative to the input-specified initial inventory. As before, the NSN and description of each processed part are listed, along with the amount, cost, and percent of total requirements. The table header CURR STK = INIT STK, ONLY COST OF ADDED BUY (= XXXX) IS AVAIL FOR REALLOCATION prints the input cost limit (denoted by XXXX above). As with all residual requirement lists, the solution mix shown does not include parts in initial inventory. Only the add-on portion is displayed and costed.

```
                    CASE= TEST NUMBER 1
  RESIDUAL(INIT STK=CURR STK STK REQ  ** ADD-ON COST LIMIT =      4300. **   PARTS IN ORDER OF DECR UNIT COST

                    ** CURR STK=INIT STK, ONLY COST OF ADDED BUY (=       4300. )   IS AVAIL FOR REALLOCATION

                                 FULL  SUBST                      NO  SUBST                          NMCS=0

        PART                          RQMNT       COST  %COST       RQMNT      COST  %COST       RQMNT       COST  %COST

1005C03489607    FEEDER ASY GUN                                     2.0       800. 18.60
1005C03699015    20MM GUN                                          70.0      3500. 81.40
```

Figure 3-18. Constrained Dollar Residual Requirements Parts List

r. Constrained Dollar Total Requirements Force Capability List (Figure 3-19). The output shows, under a "no substitution" policy and for an initial spare pool stock equal to the previously computed (paragraph p above) con-strained cost total stock requirement:

(1) Expected achievable daily and average aircraft availability.

(2) The daily and average minimum aircraft availability required to meet the base case objective.

(3) Expected achievable daily and average fraction program flying hours flown.

(4) Expected daily and average achievable flying hours per available aircraft per day.

In addition, since the achieved flying hours are computed by means of a convergence process, information on the closeness of the convergence is printed. The header TOTAL FLY HRS CONVERGED TO WITHIN X.XX PERCENT shows the closeness, denoted above by X.XX, as a percent of the total program flying hours. The value of X.XX is determined by inputs CONVF and LIMIT in record sets 1 and 3, respectively, of the Scenario Input Data Base. The percent closeness achieved will be less than 100*CONVF unless LIMIT iterations were done without attaining sufficient closeness. A smaller closeness can be achieved by reducing the input value of CONVF and/or increasing the input value of LIMIT. The value of the computed cost limit used in the case is printed in the same header format as in the Constrained Dollar Total Requirements List.

```
        CASE= TEST NUMBER 1
       ** FORCE  CAPABILITY GIVEN THAT THE COMPUTED REQUIREMENT (FOR EACH POLICY) IS STOCKED **

       ** TOTAL (INIT STK=G)COST OF *CURR INVENTORY* ADDED BUY* (=        104800. )   AVAIL FOR REALLOCATION


TOTAL  FLY HRS CONVERGED TO WITHIN   .334 PERCENT

       AIRCRAFT AVAILABILITY
                                                                  FRAC FLY HR ACH        FLY HR/AC/DAY/

              DAY        NO                                                 NO                     NO
                         SUB            REQ AVAIL             DAY           SUB                    SUB

               1       1.000              .333                 1          1.000                    3.3
               2       1.000              .500                 2          1.000                    5.0
               3       1.000              .500                 3          1.000                    5.0
               4        .860              .750                 4          1.000                    8.7
               5        .696              .750                 5           .928                   10.0
AVERAGE AVAIL           .907              .579            FRAC FLY HRS DONE=   .980  AVG FH/AC/DAY=   6.3
```

Figure 3-19. Constrained Dollar Total Requirements Force Capability List

s. Force Capability List for Constrained Dollar Residual Requirements (Figure 3-20). The output shows, under a "no substitution" policy, the same information as in paragraph r above, but for an initial spare pool stock equal to the sum of the previously computed (paragraph q above) constrained cost residual stock requirement and the original initial stock. As in the immediately preceding force capability list, information on the closeness of convergence of achieved flying hours is printed in the table header.

```
       CASE= TEST NUMBER 1
      ** FORCE  CAPABILITY GIVEN THAT THE COMPUTED REQUIREMENT (FOR EACH POLICY) IS STOCKED **

      ** CURR STK=INIT STK, ONLY COST OF ADDED BUY (=        $300. )   IS AVAIL FOR REALLOCATION

TOTAL  FLY HRS CONVERGED TO WITHIN   .668 PERCENT

      AIRCRAFT AVAILABILITY                                          FRAC FLY HR ACH       FLY HR/AC/DAY/

                                                                         NO                   NO
            DAY         SUB              REQ AVAIL              DAY      SUB                  SUB

             1          1.000              .333                  1      1.000                 3.3
             2          1.000              .500                  2      1.000                 5.0
             3          1.000              .500                  3      1.000                 5.0
             4           .860              .750                  4      1.000                 8.7
             5           .696              .750                  5       .928                10.0
AVERAGE AVAIL            .907              .579             FRAC FLY HRS DONE=   .980  AVG FH/AC/DAY=   6.3
```

Figure 3-20. Constrained Dollar Residual Requirements Force Capability List

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